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Intelligence Report

Increased Complexity in Soviet Land Arms

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Increased Complexity in Soviet Land Arms

Principal Conclusions

Soviet practice in developing weapons for land warfare has been characterized generally as conservative compared with that of the US. Design changes have been viewed as evolutionary, drawing heavily upon on-the-shelf components and often involving little more than modifications of existing systems. As a result, Soviet weapons have been described as "simple, rugged, and easy to maintain" and as cheaper to develop and produce than their US counterparts.

This characterization is more or less accurate for weapons designed in the years following World War II. However, [redacted] 25X1C
25X1C [redacted] indicates that Soviet design practice began to change radically in the early sixties. This evidence permits the following conclusions:

— All of the major new Soviet land armaments (field artillery, antiaircraft guns, and combat vehicles) introduced since 1965 are substantially more complex than the weapons they replaced.

— These weapons are not modifications of older systems but are of new designs. They incorporate major improvements in armor and tracks, and include such innovations as computerized fire control, automatic loading, and protective systems for chemical, biological, and radiological warfare. A new assault vehicle has a variable height suspension system.

— Unit costs of production, expressed in dollars, for the present generation of Soviet land arms are in most cases substantially higher than for older equipment performing similar missions. Some of the new weapons—such as the ZSU-23-4 antiaircraft gun and the BMP infantry combat vehicle—are far more costly in dollars than their closest counterparts in the US.

— The aggregate cost of the procurement programs for the new land armaments, measured in constant dollars, is estimated to be about twice that of the older systems performing similar missions. Part of this increase is the result of larger inventories, but most of it—about two-thirds—arises from more sophisticated weapon design.

CENTRAL INTELLIGENCE AGENCY
Directorate of Intelligence
September 1975

INTELLIGENCE REPORT

Increased Complexity in Soviet Land Arms

Introduction

The USSR achieved no significant technological advancements in land armaments introduced in the fifties and early sixties. The designs of these arms appeared, rather, to be evolutionary in nature and slow to incorporate radical departures from World War II concepts. Any advancements made in the postwar years usually reflected little more than modifications of older weapons. The newer Soviet weapons typically used many unchanged components (the same engine or chassis, for example) from the weapons they replaced. Because of these tendencies Soviet design practice with respect to land arms was generally viewed as emphasizing simplicity, ease of maintenance, and low cost. It is not clear to what extent this relative neglect of land arms reflected the emphasis on strategic systems during the Khrushchev period.

Whatever the cause, the simplicity of Soviet land arms has often been cited as a marked contrast to US counterparts which were more complex and costly to build and maintain. These comparisons have raised policy questions for the US on issues such as relative efficiency in resource use, lower Soviet requirements for troop training, and ease of maintenance in combat situations.

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Comments and queries regarding this publication are welcome. They may be directed to [redacted] *the Programs Analysis Division, Office of Strategic Research, code 143, extension 7117.*

Information collected in the past few years, however, indicates that the land arms introduced since the mid-sixties are far more complex than weapons previously deployed with Soviet ground forces. [redacted] 25X1C

25X1C [redacted] 25X1C

the presumption of simplicity in Soviet designs for land arms is no longer warranted.

This report assesses the extent to which the new generation of Soviet land armaments is more complex* than its predecessor. Physical and performance characteristics of the old and new equipment are compared. The report examines the impact of increased complexity* on the costs of individual weapons and discusses the magnitude and trend of total costs for major Soviet land armaments.

* For purposes of this report the terms "complex" and "complexity" as applied to land arms are used to reflect changes in physical characteristics or components. Increased complexity exists, for example, when a weapon incorporates new, improved, or innovative features such as a computerized fire control system or an automatic loader. Such features, however, need not represent significant changes in the state of the art of weapon design or manufacturing technology.

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Scope and Limitations

The complexity evident in the newer Soviet land arms impacts on the cost of developing and procuring the equipment as well as on operation and maintenance (O&M) costs. This report compares only the estimated procurement costs of these arms with those of older equipment performing similar tasks. The impact of complexity on development (RDT&E) and O&M costs has not been assessed.

Weapons Compared

The six new weapons discussed in the study represent all major categories of Soviet land arms. All six were first deployed with Soviet forces in or after 1965. For purposes of this study, the newer arms were compared with older systems being replaced by them or having similar missions. The six new weapons and the older arms involved in the comparison are listed in Table 1. Their production histories are shown in Figure 1.

Estimating Costs

The procurement costs given in this report are expressed in 1973 dollars. These dollar figures are estimates of what it would cost to produce the Soviet design in the US using base year US production technology, input prices, and profit margins.

The precision with which this is done depends to a large degree on our knowledge of the physical and performance characteristics of the individual weapons.

25X1C

[redacted]

25X1B

[redacted]

Table 1. New and Old Weapons Compared in This Study

New Weapons	Entered production	Old Weapons	Entered production
ZSU-23-4 self-propelled antiaircraft gun system*	1965	ZSU-57-2 self-propelled antiaircraft gun system	1955
BMP infantry combat vehicle*	1967	Armored personnel carriers	
		BTR-50 series	1955
		BTR-60 series*	1961
T-72 medium tank	1968	T-62 medium tank*	1961
BMD airborne assault vehicle	1969	PT-76 light tank	1951
M-1973 152mm self-propelled artillery	1971	D-20 152mm towed gun-howitzer	1953
M-1974 122mm self-propelled artillery	1971	D-74 122mm towed field gun	1955

25X1C [redacted]

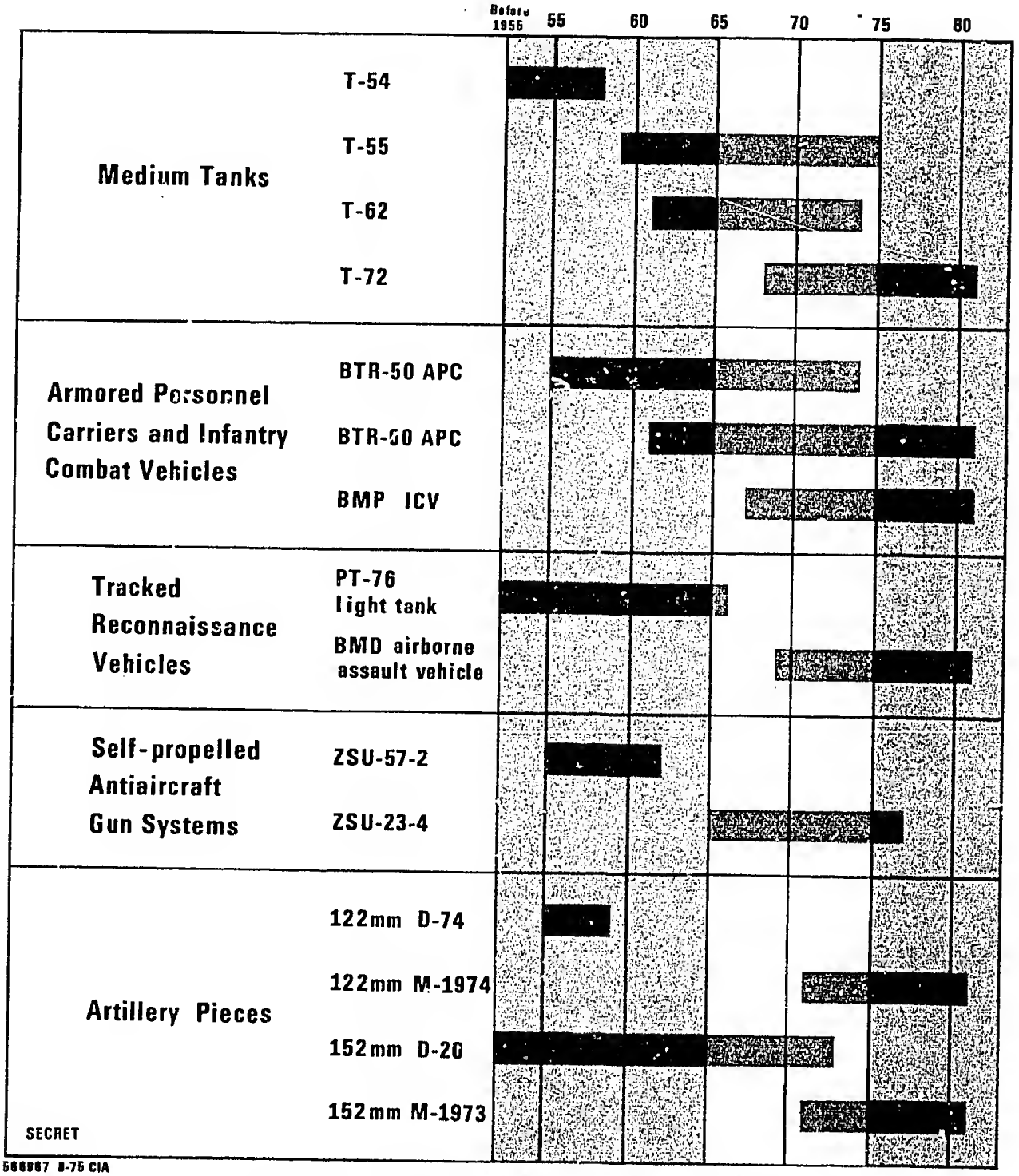
25X1B [redacted]

The other systems studied were not available for direct examination in the US. Costs for these systems, were estimated by comparing them with similar US systems and relating estimated characteristics such as weight of the weapon, bore diameter and muzzle velocity of the gun, and torque and horsepower of the engine.

25X1B [redacted]

Figure 1

Production Chronology of Major Soviet Land Arms



Note: For this paper, future production and program costs are projected only through 1981.

ZSU-23-4 Antiaircraft Gun System

The ZSU-23-4 is a self-propelled antiaircraft gun system mounted on a tracked chassis. It is equipped with four 23mm guns, an acquisition and tracking radar, and a computerized fire control system. Introduced in 1965, the ZSU-23-4 is believed to be the first deployed in the series of weapons representing a departure from the old design philosophy. Each Soviet tank and motorized rifle regiment now has four ZSU-23-4s. The ZSU-57-2, which entered production in the mid-fifties, is the only other Soviet self-propelled antiaircraft gun now deployed.

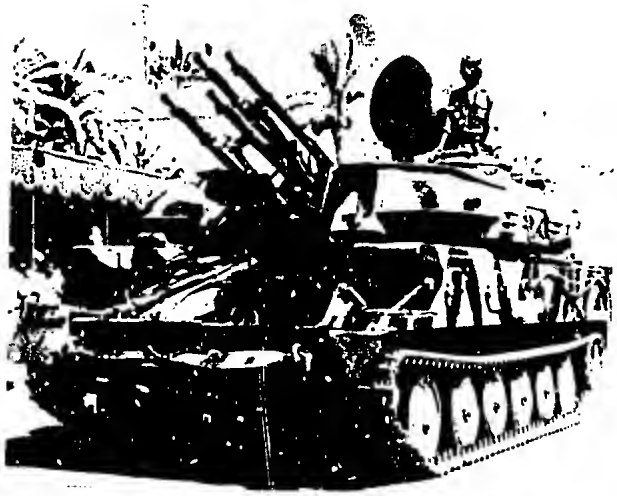
Characteristics

The significant differences between the ZSU-23-4 and the ZSU-57-2 are summarized in Figure 2. The ZSU-23-4 has four 23mm guns in a closed turret on a chassis similar in appearance to that of a PT-76 light tank, whereas the ZSU-57-2 has two 57mm guns in an open turret on a modified T-54 tank chassis. Although the ZSU-57-2 fires a larger projectile, the ZSU-23-4 has a practical rate of fire--up to 350 rounds per minute per barrel--ten times that of the ZSU-57-2.

The most significant advantage of the ZSU-23-4 over the older weapon is the addition of the Gun Dish radar and a computerized fire control system. The radar is capable of acquiring and tracking targets at a maximum range of nine nautical miles. The fire control system incorporates an analog computer to aim the guns automatically. The guns have a maximum effective antiaircraft range of about 3,000 meters. A moving-target indicator allows the subsystem to distinguish low-flying aircraft from background clutter. The crew also has the option of switching to manual tracking and optical fire control to reduce vulnerability to electronic countermeasures.

Neither the Gun Dish radar, which was developed for the ZSU-23-4, nor the fire control system reflects a significant advancement in the state of the art of Soviet electronics. The Gun Dish employs vacuum-tube circuits with hard-wired discrete components. There is no evidence of printed circuitry. Instead, the

Figure 2. ZSU-23-4 and ZSU-57-2 Antiaircraft Gun Systems



ZSU-23-4

ZSU-57-2

Selected Characteristics

	ZSU-23-4	ZSU-57-2
Main armament	Four 23mm guns	Two 57mm guns
Practical rate of fire	300-350 rounds per minute per barrel	70 rounds per minute per barrel
Acquisition and tracking	Gun Dish radar	Optical
Fire control	Computerized	Manual
Crew protection	Closed turret	Open turret
Crew	Four	Six

Soviets have employed "ruggedized" tubes that have been judged to be reliable by US contractors. The fire control system employs all-vacuum-tube technology and electromechanical devices equivalent to the level of US design capabilities in the late fifties, when this weapon was being developed. Comments from US contractors indicate that the electronics package is rugged and heavy, and constructed with high-quality material and workmanship.

The ZSU-23-4 has more sources of electrical power than does the ZSU-57-2. The ZSU-23-4 is equipped with a generator driven by the main engine, with batteries, and with a gas-turbine-driven generator to provide electrical power when the engine is disabled. The gun system can also be powered by an external electrical source. The ZSU-57-2 does not have an auxiliary generator or a means of drawing power from an external source.

The additional sources of power are most important since a loss of power on the ZSU-23-4 would disable the radar and fire control components--those features which constitute the greatest improvements in this weapon. By contrast, the lack of electrical power on the ZSU-57-2 does not seriously impair its ability to perform, because it has only a manual fire control system.

Estimated Dollar Costs

The comparative average dollar costs of the ZSU-23-4 and the ZSU-57-2 and of their major components are shown in Table 2. The average unit dollar cost for the ZSU-23-4 system is estimated to be slightly over half a million dollars, more than four times that of each ZSU-57-2. The addition of the expensive radar and fire control components on the ZSU-23-4, representing about 85 percent of the total unit cost, largely account for the difference. If these electronic components were excluded, the ZSU-23-4 would cost less than the ZSU-57-2, primarily because it is only about half the weight.

The addition of advanced electronics permits the ZSU-23-4 to operate with a smaller crew and suggests

Table 2. ZSU-23-4 and ZSU-57-2: Estimated Production and Dollar Costs

(1973 Dollars)

	ZSU-23-4	ZSU-57-2
Number of units produced	2,800*	2,600
Average unit cost for whole system	$530,000	$120,000
Average unit cost for radar	$75,000	–
Average unit cost for computerized fire control system	$370,000	–
Average unit cost for chassis, guns, and turret (without electronics)	$85,000	$120,000
Total program cost	$1,484 million	$312 million

* Includes production projected through 1977.

25X1C

some advantage in terms of the cost of training crews and maintenance personnel. US industrial representatives [redacted], however, estimate that the complexity of its equipment would require a higher degree of training than needed for personnel who operate and maintain less sophisticated equipment.

BMP Infantry Combat Vehicle

The BMP infantry combat vehicle was introduced into Soviet motorized rifle regiments in 1967. In addition to a 73mm smooth-bore gun, it is armed with the Sagger antitank guided missile, which is capable of penetrating the thickest armor now in use. Although the BMP's mission--transporting troops in a battlefield environment--is similar to that of armored personnel carriers in the BTR-50 and BTR-60 series, its armament provides an increased fire support capability over these APCs, which are armed only with heavy machine guns. In some motorized rifle regiments, the BMP has replaced the older APCs on a one-for-one basis. Because production of the BTR-60 is continuing, it appears that the Soviets will deploy a mix of BMPs, BTR-60s, and BTR-50s, at least through the seventies.

US military and industrial experts [redacted] 25X1C
25X1C [redacted] characterized it as a well-integrated and sophisticated weapon. Some of them believe it reflects improvements in tooling and engineering for production as well as a high degree of craftsmanship. They thought, moreover, that in contrast to past Soviet production practices the finishing on the BMP was excessive.

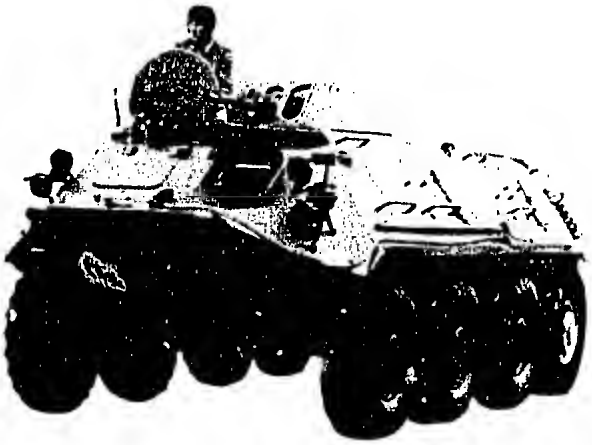
Characteristics

The most significant improvement on the BMP over older APCs is its armament *(see Figure 3)*. Its gun is far more powerful than the machine guns on the BTR-60PB and BTR-50PK, which date from the early to mid-sixties. The BMP's gun system is fed by an electrically powered automatic loader with a capacity of 40 rounds. As the loading arm places a round in the gun, the ammunition magazine advances so the next round is in position to be loaded when the arm returns to the set position. If a malfunction occurs, the operator can manually advance and load the ammunition.

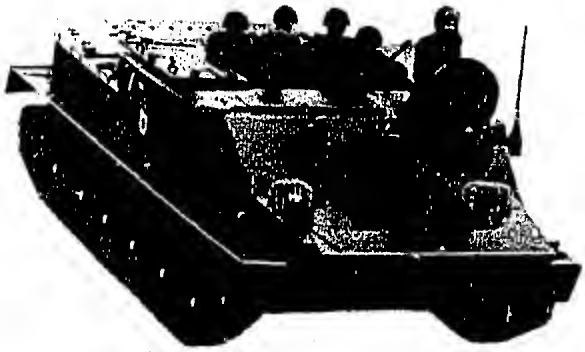
The Sagger antitank missile is launched from a rail mounted on the 73mm gun. It is optically tracked and

Figure 3. BMP Infantry Combat Vehicle and Older Armored Personnel Carriers

BMP



BTR-60PB APC



BTR-50PK APC

Selected Characteristics

	BMP	BTR-60PB	BTR-50PK
Capacity	3 crewmen 8 troops	1 crewman 10 troops*	2 crewmen 18 troops*
Main armament	73mm gun and Sagger antitank missile	14.5mm machine gun and 7.62mm machine gun	12.7mm machine gun
Engine	One V6, diesel, 300 hp	Two 6-cyl, gas-fueled, 90 hp each	One 6-cyl, diesel, 240 hp
Ability to fight from vehicle in a CBR environment	Yes	No	No

* Soviet plans appear to limit these vehicles to 8-man squads, though they have a greater capacity.

wire guided. Although not as complex as some of the new weapon systems deployed by Western armies, the Sagger adds to the overall sophistication and performance of the BMP.

The BMP also has features that enhance its capability to operate in a CBR (chemical, biological, radiological) environment. Air entering the BMP is filtered and is passed through a series of pipes to the crew compartment. This creates overpressure which seals out dirt particles and toxics. Each infantryman has optics and a rifle port operable even when the vehicle hatches are shut. Exhaust hoses are attached to the weapons to vent fumes out of the vehicle. Neither of the older APCs can operate effectively under CBR conditions.

The BMP also has an improved track, armor, and power train. The live track features double pins and rubber bushings between the track pins and treads. This increases track life, performance, and flexibility and helps to suppress noise. The BTR-50 vehicles employ dead tracks and lack the rubber bushings. The armor on the BMP is made of steel thought to be thermomechanically treated to increase its strength. The process for producing this armor is more complex and costly than that for conventionally refined armor. Although improved, the armor on the BMP, like that on older APCs, is thin and provides little protection other than against small arms fire. The engine on the BMP--a V-6 producing 300 hp--is new, as are the five-speed transmission and the power-assisted clutch and steering mechanism.

The amphibious system on the BMP, although less complex than that used on the BTR-50 and BTR-60, has some decided advantages over the older systems. While the BMP is propelled in the water by the movement of its tracks, the two older APCs have hydrojet propulsion and water exhaust ports for maneuvering. The hydrojet system has certain drawbacks. It adds weight to the vehicle, takes up space, and would prevent the installation of a rear exit. Unlike older APCs, which are exited from the top, the BMP has a rear exit that makes dismounting troops less vulnerable to enemy fire.

Table 3. BMP, BTR-60P, BTR-60PB, and BTR-50PK: Estimated Production and Dollar Costs

(1973 Dollars)

	BMP	BTR-60P	BTR-60PB	BTR-50PK
Year entered production	1967	1961	1966	1958
Number of units produced	25,450 [e]	7,200	13,300 [a, b]	3,500
Average unit cost for whole system	$140,000	$46,000	$52,000	$65,000
Average unit cost for turret and weapons	$40,000	$6,000	$11,000	$7,000
Average unit cost for chassis	$100,000	$40,000	$41,000	$58,000
Total program cost	$3,563 million	$331 million	$714 million [b]	$228 million

a. Includes production projected through 1981.

b. Takes account of an improved version projected for the lete seventies. Some 4,500 of these ere expected to be produced at a unit cost estimeted at $57,000.

Estimated Dollar Costs

On the basis of information from a defector and from calculations prepared by representatives of a US armored vehicle producer who examined it, the BMP is estimated to have an average unit dollar cost of about $140,000. It is also estimated that the Soviets will procure about 25,000 units. Of these, roughly one-third probably will be purchased from Czechoslovakia and the remainder produced in the Soviet Union. The dollar cost of the whole program is expected to be slightly more than $3.5 billion *(see Table 3)*.

The estimates of the production levels and comparative dollar costs for the BTR-60P, BTR-60PB, and BTR-50PK are much lower. The greater dollar cost of the BMP is due to the inclusion of the more complex main armament and its automatic loader, the CBR system, the Sagger missile, and the improved power train, track, and armor.

T-72 Medium Tank

The Soviets began to deploy preproduction models of the T-72 medium tank with their ground force units in the early seventies. Descriptions of the new tank provided by Soviet defectors indicate that several prototypes (collectively referred to as the M-1970 by NATO) were tested before one was selected in 1973 for mass production. The new tanks apparently will replace T-54 and T-55 medium tanks on a one-for-one basis in tank and motorized rifle divisions. There currently are 215 to 255 medium tanks in a motorized rifle division and 325 in a tank division.

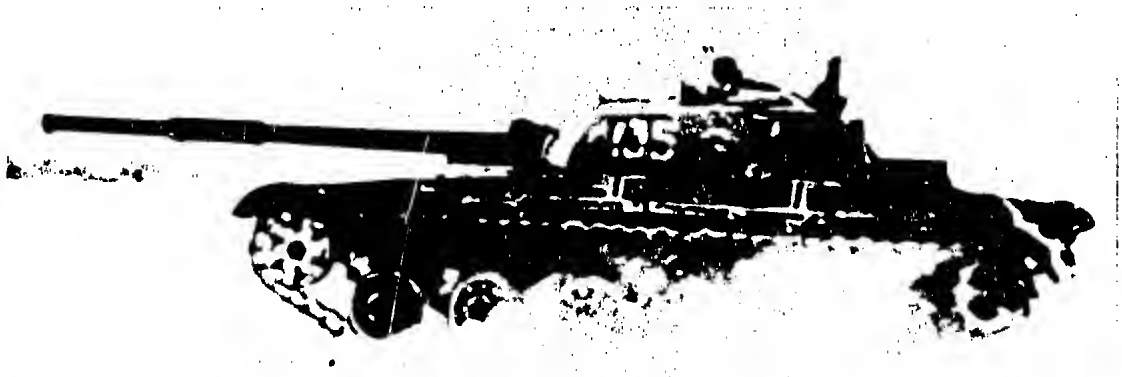
Characteristics

A comparison of the characteristics of the T-72 and T-62 *(see Figure 4)* shows that the T-72 is a substantially more advanced weapon. It is estimated to be equipped with a better gun system, improved armor, more powerful engine, a CBR protective system, and an improved track and suspension system.

The T-72 tank that has gone into production is armed with a 115mm gun which appears to be a longer model of the one mounted on the T-62. The gun on the T-72 probably fires a round that has greater velocity and accuracy but did not require a substantial design change. A significant feature of the gun system on the T-72 is the automatic loader, the first to be installed on a Soviet tank. The loader reportedly holds 15 rounds in a semicircular drum which rotates to place successive rounds within reach of the loading arm. After firing, empty casings are automatically ejected through a spring-loaded door in the rear of the turret using an ejection mechanism probably similar to that of the T-62. The addition of a loader allows the Soviets to operate the new tank with three crewmen, rather than the four required on older medium tanks.

The armor on the new tank probably is of either the spaced or the sandwich type. Spaced armor con-

Figure 4. T-72 and T-62 Medium Tanks



The T-72 probably is similar in appearance to this medium tank, apparently one of several developmental tanks known as M-1970s in the West.

T-72

T-62

Selected Characteristics

	T-72	T-62
Gun size	115mm	115mm
Weight	40 tons	40 tons
Armor	Improved armor	Conventional rolled steel
Loader	Automatic	Manual
Engine	V12, diesel, 750 hp	V12, diesel, 580 hp
Suspension and track	Double pin, live track	Single pin, dead track
CBR protection	Yes	No

sists of two pieces of armor with a space in between. Sandwich, or layered, armor consists of more than one type of armor material laminated together. The combined thickness of the pieces of armor is not necessarily greater than that of a single piece of conventional rolled steel armor, but it provides better protection against HEAT (high-explosive antitank) and kinetic-energy rounds.

25X1X [redacted] the T-72 is the first Soviet tank equipped to operate in a CBR environment. Like the BMP, the new tank probably employs a central air filtration system and overpressurization to keep toxics out of the crew compartment. It may also have a radiation liner providing additional protection in a nuclear environment. If the tank has a sandwich type of armor, the need for a liner would be diminished, according to many Western experts who contend that the filler in this type of armor would act as a shield against radiation. The T-62 is not equipped with either of these features.

The track on the T-72, like that on the BMP, probably is a live track with double pins and rubber bushings. These factors add to the durability of the track and decrease its noise level. Although the Soviets used live track on their T-10 heavy tank and some other tracked vehicles, their older tanks have not had double pins or rubber bushings.

Estimated Dollar Costs

The dollar costs for the T-72 and T-62 medium tanks are shown in Table 4. The estimated average unit cost of $270,000 for the T-72 is the aggregate of costs derived for each of its characteristics on the basis of comparisons with similar US systems. The $210,000 given for the T-62 is based on a cost estimate made by the US Army Tank and Automotive Com-

Table 4. T-72 and T-62 Medium Tanks: Estimated Production and Dollar Costs

(1973 Dollars)

	T-72	T-62
Year entered production	1968	1961
Number of units produced	30,760*	19,920
Average unit cost	$270,000	$210,000
Total program cost	$8,305 million	$4,183 million

* Includes production projected through 1981.

mand and by US industry representatives after an examination of a captured T-62.

The $60,000 difference in the estimated unit costs of these tanks is due to the large number of improvements incorporated in the new T-72 tank. About 45 percent of the increased cost of the T-72 is attributable to the introduction of armor twice as costly to manufacture as conventional armor. The remaining 55 percent takes account of the addition of a CBR protective system and an automatic loader as well as improvements in standard components such as the engine and the suspension and track.

BMD Airborne Assault Vehicle

The BMD airborne assault vehicle was initially deployed in 1972 as a replacement for the ASU-57 and ASU-85 assault guns in Soviet airborne units. It continues to replace these guns and may eventually be substituted for the PT-76 light tank in reconnaissance units subordinate to tank and motorized rifle divisions.

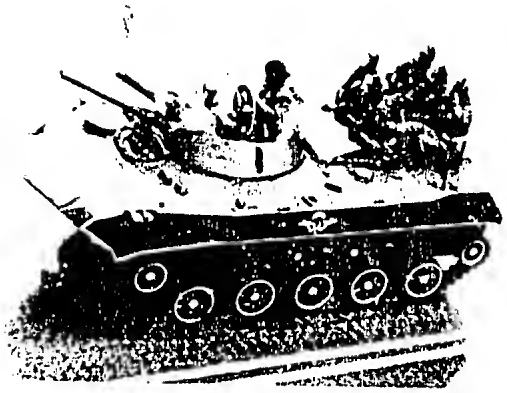
Characteristics

The BMD has many features not incorporated in the weapons it replaces. It has the same turret as the BMP infantry combat vehicle and is equipped with the same armaments--an automatically loaded 73mm gun and the Sagger antitank missile system. By comparison, the PT-76 is armed only with a 76mm gun and a light machine gun *(see Figure 5)*.

The BMD, like the BMP, has a live track which has a longer life than the type of track mounted on the PT-76. In addition to the improved track, the BMD is the first Soviet armored vehicle to have a variable height suspension system--its most significant new feature. This system enables the vehicle to be elevated to increase ground clearance in snow, mud, or rough terrain and permits it to be lowered to present a lower silhouette in a combat situation. Although details on the design of the suspension system are lacking, variable height suspension systems are inherently more complex and costly than the torsion-bar suspension used on the PT-76 and most other tracked vehicles.

Other key features are incorporated in the BMD. It probably has a CBR protective system, which increases its capability to operate in a battlefield environment where chemical, biological, or radiological contamination is present. The relatively light weight of the BMD also enables it to be air-dropped for use in an assault or reconnaissance role. By comparison, the PT-76 has no CBR system and is too heavy--about twice the weight of the BMD--to be air-dropped.

Figure 5. BMD Airborne Assault Vehicle and PT-76 Light Tank



BMD

PT-76

Selected Characteristics

	BMD	PT-76
Weight	7 tons	15 tons
Main armament	73mm gun and Sagger antitank missile	76mm gun
Automatic loader	Yes	No
Suspension	Variable height with live track	Torsion bar with dead track
Air-droppable	Yes	No
CBR protection	Yes	No
Crew	3*	3

* We believe the BMD also carries three more personnel who have assignments outside the vehicle in assault and reconnaissance operations.

**Table 5. BMD and PT-76:
Estimated Production and Dollar Costs**

(1973 Dollars)

	BMD	PT-76
Year entered production	1969	1951
Total number of units produced	4,350*	6,150
Average unit cost for whole system	$95,000	$130,000
Average unit cost for turret and weapons	$40,000	$60,000
Average unit cost for chassis	$55,000	$70,000
Total program cost	$413 million	$800 million

* Includes production projected through 1981.

Estimated Dollar Costs

Although the BMD airborne assault vehicle has more advanced features than the PT-76 light tank, the estimated dollar cost of the BMD is about three fourths that of the PT-76 *(see Table 5)*. The greater cost of the PT-76, despite its relatively lower level of complexity, is due to the greater amount of material required to produce it. By replacing the PT-76 with the BMD, the Soviets could produce and procure a vehicle having greater capability at lower cost.

M-1973 and M-1974 Self-Propelled Artillery

The Soviets relied on towed artillery to provide their troops with fire support in the battlefield area from World War II through the sixties. In the early seventies, they introduced their first self-propelled artillery weapons--the 152mm M-1973 mounted on an SA-4-type chassis and the amphibious 122mm M-1974 mounted on a chassis similar to that of the PT-76 light tank. The armored self-propelled weapons are better suited than towed artillery for deployment with rapidly moving tank and motorized rifle units and also provide better protection for their crews. The M-1973 is replacing, on a one-for-one basis, the eighteen 152mm howitzers in artillery regiments of motorized rifle divisions and eighteen 122mm howitzers in artillery regiments of tank divisions. The M-1974 is replacing the six 122mm howitzers in motorized rifle regiments of both tank and motorized rifle divisions, also on a one-for-one basis.

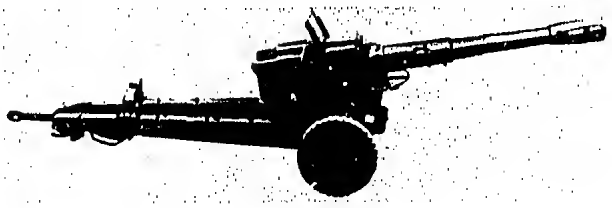
Characteristics

The more advanced features of the newer weapons result primarily from the addition of new components. These components include an automatic loader and a turret structure that are not on the towed artillery pieces. In addition, the newer weapons may have a CBR protective system. *(See Figure 6.)*

The guns on the new weapons appear to be adapted from those on older towed pieces. The 152mm gun on the M-1973 closely resembles the 152mm D-20 and the 122mm gun on the M-1974 is similar to the 122mm D-74. In both cases, the new weapons probably are comparable to the old ones in firing performance. At least one of the self-propelled guns, however, has an automatic loader capable of operating at a high rate of speed. The resulting increased rate of fire, as compared with that of the older weapons, enables it to put more rounds into a target area before the enemy can obtain adequate cover. The other new gun also may have an automatic loader, but there is no evidence to confirm this.

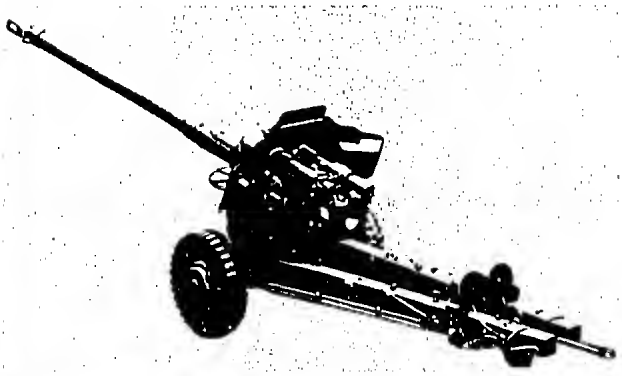
Figure 6. Soviet Self-Propelled Artillery and Towed Gun Systems

M-1973



D-20

M-1974



D-74

Selected Characteristics

	M-1973	D-20	M-1974	D-74
Caliber	152mm	152mm	122mm	122mm
Prime mover	Self-propelled, mounted on an SA-4-type chassis	AT-S-type artillery tractor	Self-propelled, mounted on a PT-76-type chassis	AT-S-type artillery tractor
Protection against antipersonnel munitions	Overhead armor	None	Overhead armor	None
Amphibious	No	No	Yes	No
CBR protection	Probably	No	Probably	No
Loading operation	Probably automatic	Manual	Probably automatic	Manual

The gun on each of the new self-propelled weapons is mounted in a turret. It provides protection against antipersonnel munitions and allows for quicker directional adjustments of the gun than are possible on towed weapons. Turreted artillery has been used in the West since World War II, but this is the first instance of its deployment with Soviet ground forces.

Although there is no firm evidence that either of the newer artillery pieces has a CBR protective system, the incorporation of this type of equipment on other new Soviet weapons suggests the self-propelled artillery weapons may have such a system. This would permit the crew to fire from a sealed vehicle, whereas the crew of a towed weapon has to operate in the open.

Estimated Dollar Costs

Introduction of the new artillery weapons has resulted in a significant increase in the estimated dollar costs of Soviet artillery procurement. *(See Table 6.)* The unit costs for the self-propelled weapons are 50 to almost 100 percent greater than those of the D-20 and D-74 towed weapons and their artillery tractors.

As shown in Table 6, the 152mm M-1973 has an estimated dollar cost of about $140,000, and the 122mm M-1974 about $110,000. It is estimated that the Soviets will purchase approximately 6,000 units of each weapon. This purchase would cost about $1.5 billion.

Both older weapons--the D-20 and D-74--have an estimated average unit dollar cost of $55,000. They usually are towed by an AT-S or similar artillery tractor costing about $20,000. The estimated cost of each towed weapon and its prime mover is approximately $75,000. The total cost for the D-20 program including artillery tractors is about $310 million. The total estimated cost for procuring the D-74 weapons and tractors is about $160 million.

The chassis of the new self-propelled artillery accounts for some of the difference in dollar costs. The major share of the difference, however, results from the greater complexity--attributable to the

Table 6. M-1973 and M-1974 Self-Propelled Artillery, D-20 Howitzer, and D-74 Field Gun: Estimated Production and Costs

(1973 Dollars)

	M-1973	D-20	M-1974	D-74
Year entered production	1971	1953	1971	1955
Number of units produced	6,050*	4,100	6,050*	2,100
Average unit cost for the weapon	$140,000	$55,000	$110,000	$55,000
Average unit cost for the AT-S prime mover	—	$20,000	—	$20,000
Program cost	$847 million	$308 million	$666 million	$158 million

* Includes production projected through 1981.

turret, automatic loader, and protective systems--of the newer weapons. The Soviets probably will use these weapons primarily to support maneuver units, while continuing to rely on towed artillery to provide the bulk of their fire support for breakthrough operations.

Impact of New Weapons Costs

Translating unit costs of each of the new weapons into total procurement costs is complicated by the fact that all of them are still being manufactured. Our estimates of total production must, therefore, include projections of future production.

The accumulated dollar procurement costs of all the new land arms at the production levels we have projected is about $15 billion *(see Table 7)*. This is more than twice the dollar costs estimated for

Table 7. Comparison of Program Costs for Old and New Land Arms

(1973 Dollars)

	Average Unit Cost	Quantities	Estimated Years of Production	Program Costs: New	Program Costs: Old
				(Millions)	
Antiaircraft guns					
ZSU 23-4	$530,000	2,800	1965-77	$1,484	–
ZSU-57-2	120,000	2,600	1955-62	–	$312
Armored vehicles					
BMP	140,000	25,450	1967-81	3,563	–
BTR-50 series	65,000	3,500	1955-74	–	228
BTR-60 series	51,000 *	20,500	1961-81	–	1,045
BMD	95,000	4,350	1969-81	413	–
PT-76	130,000	6,150	1951-66	–	800
Tanks					
T-72	270,000	30,760	1968-81	8,305	–
T-62	210,000	19,920	1962-74	–	4,183
Artillery					
M-1973	140,000	6,050	1971-81	847	–
D-20	75,000	4,100	1953-73	–	308
M-1974	110,000	6,050	1971-81	666	–
D-74	75,000	2,100	1955-59	–	158
Total program costs				$15,278	$7,034

* Weighted averege of average unit costs of the BTR-60P and of the present and projected improved versions of the BTR-60PB.

the older systems. Part of this increase--about 35 percent--results from larger production runs projected for most of the newer systems.* The remaining 65 percent results from the higher production costs of the newer weapons.

As seen in Figure 7, annual dollar costs for the older generation of weapons began to decline in the late sixties. This decline, however, was more than offset by the rapid increase in the dollar costs for procurement of newer systems. By 1975 the costs reach an estimated $1.3 billion.

The average annual rate of growth for major land arms during the period 1965-75 was about 6 percent. As a result, their share of total Soviet weapons procurement--in dollar cost terms--increased from 4 percent in 1965 to 6 percent in the mid-seventies. The share of total defense costs, however, remained well below 2 percent.

Projected programs imply continued growth in the costs of major land armaments over the remainder of the decade, although at a reduced annual rate. This growth appears well within the capacity of the Soviet defense industry and would have only a marginal impact upon total defense outlays.

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* The applicable formulas are:

$$\frac{\Sigma P_o Q_n}{\Sigma P_o Q_o} = 137 \text{ percent}$$

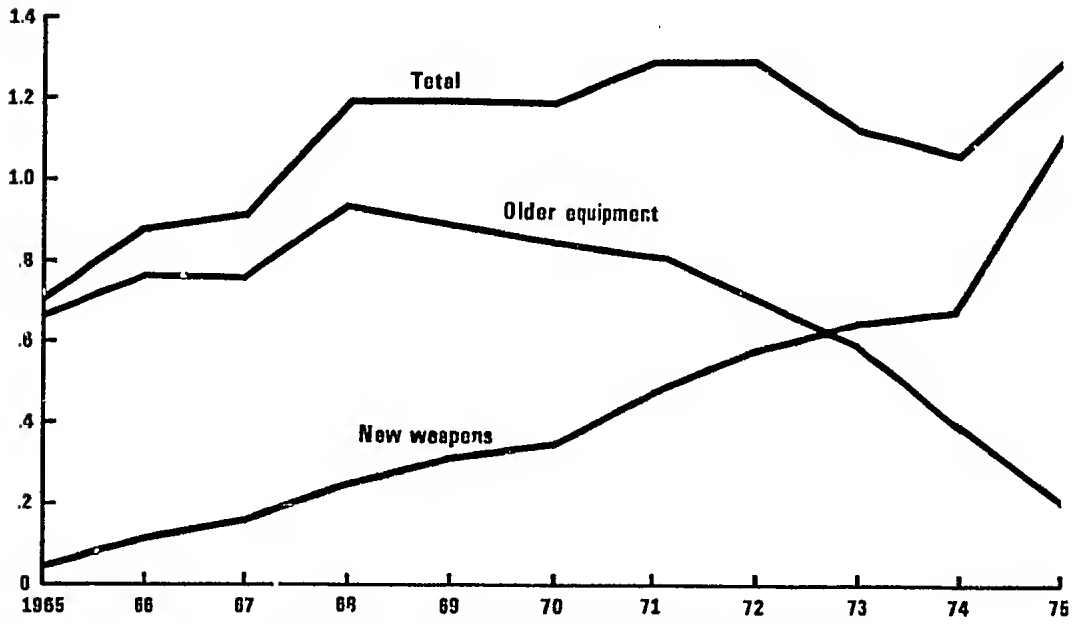
$$\frac{\Sigma P_n Q_n}{\Sigma P_n Q_o} = 133 \text{ percent}$$

Where: P_o is the price of the old system.
P_n is the price of the new system.
Q_o is the quantity of old systems procured.
Q_n is the quantity of new systems procured.

This is to say that, using either set of price weights, the difference in the production levels accounts for about 35 percent of the increase in total program costs.

Figure 7

Dollar Costs of Estimated and Projected Major Soviet Land Armaments Programs, 1965-75*



*Including all combat vehicles, artillery weapons, and antiaircraft guns.

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